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Who do you care about? Scientists' personality traits and perceived beneficiary impact

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Abstract

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ABSTRACT

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Keywords: psychological motivations, big five personality traits, biomedical research, perceived beneficiaries

1. Introduction

> "Social impact (of science) is difficult to plan; it sometimes happens unexpectedly, or can even be unintended. It is only by analysing the processes that induce impact that we have a chance of recognizing potential research impacts and the contributions made by research that might otherwise not be evident" (Spaapen and van Drooge 2011, p. 213).

In the last decades, there has been a visible trend promoted by policy makers and science funders to demonstrate the value of science for addressing societal problems (Bornmann, 2013; Martin, 2011). The assumption that non-academic groups can automatically reap the benefits of scientific knowledge is under strict scrutiny, and this has been evidenced by a number of policies promoting the societal accountability of science. For instance, the scope of research evaluation has widened to account for broader societal returns (Donovan, 2011). Research about the third mission of universities or the triple helix metaphor, and on the convenience of cross-organisational research (Etzkowitz et al., 2000; Gibbons et al., 1994; Molas-Gallart et al., 2002) also urges a consideration of the societal return of knowledge as a primary goal of academic institutions.

In this environment, scientists have come under increasing pressure to redesign their research agendas to these demands. However, we still lack understanding on the individual characteristics of scientists who are more able to accommodate their research to this novel landscape. It remains the case, however, that the final decision to reorient and design research agendas is still reserved to the individual scientist (Stern, 2004; Tartari and Breschi, 2012). Grounded on the idea that individuals are the fundamental origins of collective phenomena (Coleman, 1994; Felin and Foss, 2005), this paper is motivated by the need to understand whether and why individual scientists differ in the adoption of societal impact as a core aspect of their research activities. Findings from recent studies have challenged the view of scientists as an homogeneous group, showing that they differ in their "taste for science" (Roach and Sauermann, 2010) or in their preferences for publishing (Sauermann and Roach, 2014). Specifically, a first goal of this paper contributes to this stream by considering the possibility that scientists under similar institutional and individual conditions can make different evaluations regarding the potential beneficiaries of their research activities.

To do so, we build on and complement some strands of literature. First, we discuss the concept of beneficiaries of science in a broad sense. This concept has been separately employed in research evaluation (Lyall et al., 2004; Molas-Gallart et al., 1999) and management psychology (Belle, 2014; Grant, 2012; Grant et al., 2007), but never combined. This research focuses on the biomedical field, where non-academic actors such as patients or industry are pivotal actors to move knowledge "from the bench to the bedside" (Bornstein and Licinio, 2011; Collins, 2011). Results indicate that potential beneficiaries of biomedical science can be grouped into three audiences: research community, industry, and patients and clinical practitioners, and scientists seem to differ in the weight they attach to each of these groups.

We draw upon this categorization to posit a second objective of this paper. That is, we analyse the sources of these differences in perceived beneficiaries in terms of personality traits and motivations. The influence of individual motivations and personality traits has been analysed in fields other than science studies, with exceptions (Sauermann et al., 2010; van Rijnsoever et al., 2008). Merging science studies with the psychology of personality is relatively new. Adding psychological characteristics of individuals to the more usual socio-demographic, organizational and institutional factors will enrich the explanation of scientific activities and their impact. Some psychological characteristics may modify the importance previously attributed to those other factors. So far, previous work has not tested whether autonomous, controlled or prosocial motivations predict scientists' preferences for a specific population. We do not know much either yet about the role of open, extroverted or conscious personalities in pushing the direction of biomedical research. And, whereas we have learnt lessons on intra-academic and university-industry relations, relations between scientists and the third sector, society (proxied in this study through patients), remains unexplored. In the next sections we deepen into the literature review and present the results of a survey that measured typical constructs from the psychology of personality to address these questions in the field of science studies.

The following paper is structured as follows. First, we review the research on the societal impact of academic research. We then contextualize our study by discussing potential beneficiary groups in the biomedical field. This lead to a discussion of personality traits and motivations as potential antecedents of scientists' perceived impact on beneficiary groups. We exploit data from a large-scale survey to biomedical scientists to test our hypotheses. We end up by reporting our results and discussing our findings, and derive potential implications for practice.

2. Background literature and research hypotheses

2.1. Biomedical *scientists' impact on different beneficiaries*

2.1.1. Science and societal impact of research

Scientists deliver results for their academic peers and a wider range of communities. They generate academic knowledge and solve societally relevant problems (De Fuentes and Dutrénit, 2012). The rationale behind public support of science is largely based on the fact that scientific outputs produce socially and economically relevant benefits (Bozeman and

Gaughan, 2007). Public and private granting bodies are taking a proactive role in demanding scientists to delineate in their research proposals the positive impact of their research outside the lab (Owen-Smith and Powell, 2001). Relatedly, the scope of research evaluation has broaden up, incorporating societal impact as an indicator of success (Mostert et al., 2010). Ideally, these policies seek scientists to integrate in a transdisciplinary way the knowledge and needs coming from different beneficiary groups (Kasemir, 2003), which should permeate their research agendas (Olmos Peñuela et al., 2014).

There is a broad consensus about the importance of supporting ‘productive interactions’ between scientific and societal spheres as a way to generate scientific knowledge with greater societal impact (Spaapen and van Drooge, 2011). But, are all scientists equally equipped to accommodate and adopt non-academic priorities as part of their research agenda? Evidence reveals that individuals differ in the way they adopt supportive norms, routines and behaviours (Hogg and Terry, 2000). Some scientists may perceive that the norm of openness is compromised when non-academic actors gain weight in the research via industry funding (Walsh and Hong, 2003), due to the imposed limits on knowledge disclosure. (Lam, 2011) referred to the concept of ambivalence of scientists for understanding the tensions between the traditional norms of science and the need to engage with non-academic actors, thus assuming divergent scientists’ attachment to the traditional values of science. In this regard, this study argues that individual scientists differ in the degree of importance they attach to potential beneficiaries of their research activities.

2.1.2. Who benefits? Conceptualizing beneficiaries of research

Performing societally relevant research implies exerting an impact over individuals or groups beyond academia. For instance, a focus of concern in biomedical science regards the gap between knowledge advances and their application (Coller, 2008). However, identifying and separating who are the potential beneficiaries of a given research activity from one another is neither easy nor trivial. Salter and Martin (2001) suggested a partition between the economic and non-economic benefits of scientific activities to evaluate the positive externalities of scientific research, but explicitly acknowledge the fuzzy boundary between both impact types. Similarly, Lyall et al., (2004) proposed a research evaluation method based on the identification of diverse end-users of public sector research organizations, and a categorization between upstream end-users, collaborators, intermediaries, and downstream end-users. And Molas-Gallart et al., (1999) accentuated the importance of considering the indirect and non-linear nature of research impacts and introduced the concept of "beneficiaries" to distinguish between groups that may be potentially affected by the obtained results from a research project. On the whole, the existing models have delivered insights on the complexity associated to the identification and allocation of research efforts across diverse beneficiary groups. However, there is not yet an accepted framework to identify potential beneficiaries of scientific research, and this has led to a lack of understanding of the origins of societal impact of science (Bornmann, 2013).

We propose to focus on the individual scientist as a valid source of information to identify and attribute differential weights to diverse beneficiary groups. We contend that the societal relevance of knowledge depends, in part, on the extent to which researchers consider the applicability of their work over diverse beneficiary groups at early stages of the research cycle. This is likely to influence their decisions on how they address research questions (Arvanitis et al., 2008). For a more precise understanding on the effects of beneficiary identification, we incorporate insights from the organizational behaviour literature. Within this field, approaches to job design have pointed to the importance of explicitly recognizing the impact on beneficiaries as a source of dedicated effort (George, 2009; Grant, 2007; Grant and Berry, 2011). Here, perceived beneficiary impact is defined as "the degree to which employees are aware that their actions affect others" (Grant, 2007: 399). In other words, it represents an explicit belief of individuals that they have opportunities to benefit others through their work. As it is defined, potential beneficiaries may include individuals and groups, either internal or external to the organization. These comprise academic colleagues, patients, communities, supervisors, companies, etc. (Grant, 2007). Research indicates that heightening the perception of individuals as making a difference in others (namely, beneficiaries) will induce to devote greater efforts and persistence towards reaching them (Belle, 2014; Bellé, 2013; Grant and Campbell, 2007). Grant et al. (2007) found that connecting fundraising workers' with the beneficiaries of the collected funds increased the workers' dedication and effort, which turned into larger funds gathering. Beneficiary impact seems to be particularly important when concerning public service workers, such as scientists working at public research institutions. Workers with a greater awareness about the impact of their work in society tend to perform better, as they are infused with a larger prosocial purpose (Moynihan and Pandey, 2007). By connecting lessons on the societal impact from research and theory on perceived beneficiaries, our premise is that biomedical scientists differ in the perceived impact they attach to different communities.

2.1.3. Perceived beneficiaries in the biomedical sector

Concerning the biomedical context, interest in focusing on the impact of biomedical research over non-academic beneficiaries is rising. Traditionally, scientific significance and scientific value of research among the academic community has been the highest priority when evaluating academic research. Novel approaches to biomedical research based on translational models are struggling to give more weight to non-academic beneficiaries (Arar and Nandamudi, 2012; Collins, 2011). For instance, in certain biomedical fields such as rare diseases, patient associations are major players in defining scientific research agendas (Fleurence et al., 2013; Mavris and Le Cam, 2012). Because patients are direct recipients and beneficiaries of biomedical research, they should be considered as legitimate actors to get involved in science-related decision making. Despite that the participation of beneficiaries in decision-making of biomedical science seems to be widely supported, studies on whether biomedical researchers actually attach importance to non-academic agents remain scarce. Few works suggest that scientists vary on the explicit awareness they attach to different beneficiary groups. For instance, (Weijden et al., 2012) surveyed 188 biomedical group leaders on the importance they attached to the societal orientation of their research activities. They found that, overall, scientists showed a positive view towards the societal impact of research, although differences were found depending on whether the research group was para-clinical, clinical or pre-clinical. Relatedly, (Hobin et al., 2012) revealed that the opportunity to conduct research that has an impact on human health was a key factor in explaining scientists' decisions to build their research agendas and select those projects with clearer societal impact. Our point is that psychological characteristics of these individuals will help explaining which beneficiaries they address.

2.2. The influence of psychological motivations and traits on biomedical *scientists' perceived* impact on beneficiaries

Science studies have established that scientists' heterogeneity regarding their allocation of efforts on beneficiaries depends on socio-demographic variables (age, sex, status or occupation), distribution of tasks (research and development, teaching, consultancy, management), scientific field, nature of research (basic, applied), institutional and organisational culture, etc. Scholars have focused on factors alike as the basis to explain why some scientists are more prone to exert an impact beyond academia. Examples include public scientists' involvement in university-industry relations (Azagra-Caro et al., 2006; Bonaccorsi et al., 2012), entrepreneurial attitudes (Philpott et al., 2011), academic engagement (Perkmann et al., 2013), or local contributions to development (Stachowiak et al., 2013; Uyarra, 2010).

Sometimes those covariates control for the relation between scientific production and interaction with firms (Hottenrott and Lawson, 2014; Manjarrés-Henríquez et al., 2009).

Psychological characteristics have been largely skipped of the question in science studies. In its parent field of innovation studies, psychological characteristics have been occasionally used, among others: relation between type of consumer innovativeness (how much the consumer likes to try new things) and purchase of new products (Goldsmith et al., 1995); influence of religious-driven personality type on style of R&D management (Ta-Cheng, 1997); association between personality traits, entrepreneurship and innovativeness (e.g.: (Marcati et al., 2008), etc. Similar efforts applied to science studies are scarce. We join some authors in calling attention about this omission (Rothaermel et al., 2007; Tartari and Breschi, 2012). An exception is the work by (van Rijnsoever et al., 2008)), who found a positive effect of academic innovativeness on interactions with other academic partners, not with industrial ones. We will include patients as potential beneficiaries of interactions and use a more refined measurement to capture this explicit awareness. Among the plethora of possible psychological characteristics, we will start by choosing two widespread constructs from the literature: motivations and personality traits. In the next paragraphs, we justify their importance.

Hypothesis 1. Psychological characteristics such as motivations and personality traits modify the significance of some socioeconomic factors in explaining biomedical scientists’ perceived impact on beneficiaries.

While psychological characteristics have been largely neglected from science studies, it would be unfair to say that every psychological aspect has been remained absent. The study of motivations has been addressed, and motivations are linked to psychology. We have learnt, for instance, that academics’ motivation to engage into partnerships with industry is to increase their scientific prestige (Azagra-Caro et al., 2008), or that both academics and industrialist seek stability but not control, and benefits for their organisations rather than for society (Ankrah et al., 2013). To reach society in general, scientists aim to improve their teaching and communication skills (Melton et al., 2005), or the desire to increase the public's interest in and enthusiasm for science, the public's scientific culture, and public awareness (Martín-Sempere et al., 2008).

Besides this, few authors have captured motivation differences through validated psychological scales. To elaborate further on the role of motivations in the scientists' awareness of their societal impact, we build on self-determination theory (Deci and Ryan, 2000, 1985), which concurs that the engagement in behaviour can vary with respect to how autonomous it is, so two broad forms of motivation arise: autonomous and controlled. The former refers to actions that emanate from or congruent with one’s self, and reflects one’s personal values and interests. In contrast, controlled motivation is mainly fuelled by internal or external pressures, such as tangible rewards or different forms of social recognition. Besides these two broad categories, it has been recently emphasized that the explicit desire to benefit others through ones’ behaviours form the basis of a third category of motivation, namely prosocial motivation (Grant, 2008; Grant and Berry, 2011).

All three types of motivations are powerful drivers of action, and contrast with a situation of amotivation, that is, a lack of intention to act because of the absence of a contingency between one’s actions and outcomes (Deci and Ryan, 1985). We predict that when scientists exhibit greater levels of motivation, their perceived impact on all beneficiary groups will be higher, as compared to scientists closer to a situation of amotivation. We expect that this relationship will hold by all three motivation categories: autonomous, controlled and prosocial. Thus, we posit the following hypothesis:

Hypothesis 2. Being motivated increases biomedical scientists' perceived impact on all beneficiary types (research community, industry and patients), no matter the type of motivation (autonomous, prosocial or controlled).

Other psychological characteristics apart from motivations are psychological traits. These are stable individual characteristics that explain the person's behaviour in different situations (Allport, 1937; Cattell, 1946; Eysenck, 1950). One of the most notable theories is the Five Factor Model, which considers that the so-called big five personality traits define a person: openness to experience, conscientiousness, extraversion, agreeableness (a.k.a. teamwork) and neuroticism (a.k.a. emotional instability) (Costa and McRae, 1985; Goldberg, 1981).

The study of the big five psychological traits applies to many fields of human action, like job performance (Fernandez-Zubieta et al., 2013), career success (Judge et al., 1999), love relations (Shaver and Brennan, 1992), personal values (Roccas et al., 2002)… so it is plausible to expect a certain relation with scientific activities, including impact of research on beneficiaries. In the typical quantitative study, the target variable has several categories, e.g. job performance can be that of jobs related to "training proficiency", "occupations involving social interaction", etc. (Barrick and Mount, 1991); career success can be "job satisfaction" or "high income/status" (Judge et al., 1999); personal values can be "self-direction", "universalism", "achievement", "conformity" (Roccas et al., 2002), etc. The relation between each category and each one of the big five personality traits is rarely exhaustive or univocal, but rather complex. For instance, performance of jobs related to training proficiency is related to openness to experience, conscientiousness and not to any other trait; conscientiousness is also related to performance of occupations involving social interaction, but not to openness to experience; instead, it is related to extraversion, and so on (Barrick and Mount, 1991). Similarly for career success (Judge et al., 1999) or personal values (Roccas et al., 2002). Hence, as compared to psychological motivations, which are supposed to affect every beneficiary type (previous hypotheses), we expect that psychological traits will have differential effects on each type.

Hypothesis 3. Biomedical scientists' perceived impact varies across beneficiary types according to different personality traits.

Predicting the direction of change of concrete personality traits on particular beneficiary types is difficult[1], but we will try to delineate some major relations based on norms of scientists and technologists (Dasgupta and David, 1994) and the scarce literature on the personality traits of scientists (Feist, 1998; Lounsbury et al., 2012).

Academic scientists are particularly open to experience (Feist, 1998; Lounsbury et al., 2012) but also less conscientious, extroverted or emotionally stable than other professionals (Lounsbury et al., 2012).[2] We can then assume that scientists addressing the research community will stand out for their openness to experience and other scientists for the three remaining traits.

There are additional justifications to expect a positive effect of openness on preference for the research community. Openness is the core norm of academic science. The term openness in the economics of science refers to scientists' preference for non-pecuniary over pecuniary rewards, for disclosure over secrecy and for the academic over the commercial world (Dasgupta and David, 1994). As one of the big five personality traits, openness (more exactly openness to experience) describes intellectual, curious, broad-minded people (Costa and McCrae, 1992). The parallelism between both uses of "openness" is quite straightforward, which sustains the expectation that openness, as a personality trait, is particular of the

[1] van Rijnsoever et al. (2008) acknowledge the importance of the Big Five model but put it in this way: "not all factors are of likely influence on our dependent variables" (p.1258), and used it as an argument to confine to one single personality trait typical from the management literature: global innovativeness. We are taking the risk to approach the analysis of the effect of the big five personality traits on our dependent variable.

[2] They score average on agreeableness, although it contributes positively to their career satisfaction (Lounsbury et al., 2012).

scientific norm. Some evidence supports so. Openness is associated with high performance in jobs that require proficient learning like scientists (Barrick and Mount, 1991), with valuing self-direction and universalism and in conflict with the motivational goals of conformity, tradition, and security (Roccas et al., 2002) like academic scientists. Open individuals pursue knowledge and engage into intellectual activities to achieve it (Furnham et al., 2008).

Hypothesis 4. Openness to experience will increase biomedical scientists' perceived impact on research community.

We said, conscientiousness, extraversion and neuroticism might be typical of scientists whose research is mainly concerned with non-academic audiences, namely industry or patients in our background. How to differentiate which trait identifies better which group?

We know some features of industry-oriented scientists. The industrial norm for a scientist – or a technologist in Dasgupta and David's word (1994) – means being genuinely interested in commercial, industrial and military research and development activities, and prone to secrecy and pecuniary returns. Scientists are unstable (Lounsbury et al., 2012) and unstable extraverts perceive monetary rewards as stimulating signals of success (Gray, 1987) – disputed by (Brandstätter and Brandstätter, 1996), so we may consider extraversion as typical from technologists. In addition, introverts succeed in academic environments, which extraverts find it boring (Eysenck, 1971), so extraverted scientists may prefer orienting their research towards wider collectives, e.g. industry. Extraversion is positively linked to performance of jobs involving social interaction, managers and sales (Barrick and Mount, 1991), e.g. with professions related to industry, and more concretely with enterprising, which includes entrepreneurship (Berings et al., 2004). We may think that a technologist will stand out for these features.

Hypothesis 5. Extraversion will increase biomedical scientists' perceived impact on industry.

We are left with scientists whose research is devoted to patients. The normative difference between academic scientists and technologists does not tell us much about this group. Curing patients may involve research close to clinical practice, neither in the frontiers of science, nor for commercialising marketable products. A biomedical scientist interested in patients' needs to have a firm societal commitment beyond earning scientific prestige or income. Putting less weight on earnings characterises interest in social occupations (Berings et al., 2004), so we may foresee that scientists who orient their research towards patients will not exhibit the same traits as those who orient their research towards industry (extroverts according to Hypothesis 5). Conscientiousness is a personality trait equivalent to having a sense of purpose, obligation, and persistence, to being careful and pursuing success according to socially approved standards (Roccas et al., 2002). Notice as well that most biomedical scientists are not practitioners, so patients are the last of his target audiences. Only more thorough and harder working employees will find time for caring about patients, i.e. more conscientious.

Hypothesis 6. Conscientiousness will increase biomedical scientists' perceived impact on patients.

With this, we end stating hypotheses about predicted relations between concrete personality traits and particular beneficiary impacts. For two of the big five personality traits, we do not predict any particular effect: neuroticism and agreeableness. Neuroticism is typical from scientists (Lounsbury et al., 2012) so we should expect some kind of significant effect, but we are not able to foresee why it should be stronger on a single beneficiary type. Agreeableness is not typical from scientists (Lounsbury et al., 2012), so there is no reason to expect it to have a significant impact on a single beneficiary type.

3. Methods

3.1. Research setting and research procedure

The data for this study was collected through a large-scale survey to biomedical scientists in Spain. The survey was administered to 4,758 biomedical scientists and technicians belonging to research groups actively working around nine biomedical fields (diabetes, obesity, hepatic and digestive diseases, neurodegenerative diseases, rare diseases, mental health, bioengineering, respiratory diseases and public health). The questionnaire was sent electronically in April 2013. We obtained explicit support from the scientific directors of the groups to conduct the survey (5 out of 9 of them wrote support letters), and scientists were highly encouraged to participate. The choice of research population was based on a number of reasons. First, the population covers a representative spectrum of biomedical research held in Spain. One important peculiarity of this sample is that our respondents may be located a diverse institutional settings. In particular, the sample includes scientists from university departments, hospitals, public research organizations and private foundations. In terms of biomedical sub-specialties, our population captures a broad palette of disciplines, as stated above. Second, all respondents are part of the CIBER program, which covers a large number of biomedical areas in Spain. CIBER is a policy initiative which was launched in 2006 by the Spanish Government. In 2006, the Ministry of Health published a series of open calls for research groups located in Spain, aimed to create research consortiums around diverse biomedical fields. The main goal of the program was to promote collaborative research between scientists and to provide solutions to health problems with large societal prevalence in the Spanish National Health System (Delgado Rodríguez, 2012). Third, biomedicine is a field where non-academic communities play an important role in shaping scientists' research priorities. Much has been recently written about how participant-centric initiatives provide the basis for tightly connections between academic research and patients' needs (Kaye et al., 2012). All these reasons lead us to expect that scientists from our sample will account at least a minimum level of perceived impact in non-academic beneficiaries.

The questionnaire consisted on various sections. One section aimed to capture data on the scientists' motivations and personality differences. All scales were based on previous literature and adapted to the biomedical field when needed. Other section referred to their perceived impact on different societal groups, which constituted the basis for our dependent variables. A final section of the survey included various socio-demographic aspects, such as the scientists' age, academic position or academic background, which constitutes the basis for our control variables. Both the independent and dependent variables were operationalized through self-reports. Although potential biases of survey instruments are quite well acknowledged, the advantages of self-reports are particularly appealing when dealing with human behaviour studies, as in this case (Howard, 1994). Prior research in related areas also relied on a survey approach to obtain this type of detailed data (D'Este and Perkmann, 2011; Link et al., 2007; Walsh et al., 2007). All respondents were ensured that their individual responses would be reported only in an aggregated manner, so that no individual respondent could be identified. Respondents were also assured strict confidentiality, and individual responses were sent directly to us.

Before sending out the survey, we conducted a pilot study to 15 biomedical scientists, which helped us to refine the wording and validate the sense of the questions. This pretest did not lead to any major change, but helped to clarify some of the questions. We obtained a response rate of 27%, which is consistent with previous studies involving scientists (Perkmann et al., 2013; Tartari and Breschi, 2012). Due to missing values only 1033 observations in maximum could be used in the econometric analyses.

Table 1 summarizes descriptive statistics and Table 2 the Pearson correlation coefficients for the variables we explain in the next sub-sections.

{Table 1 here}

{Table 2 here}

3.2. Dependent variables

Perceived impact on beneficiaries. To capture the scientists' awareness of their research impact across different groups, we resorted to the concept of perceived beneficiaries (Grant, 2007, 2012; Maurer et al., 2002). The goal was to compile an extensive list of societal or professional groups that may benefit, directly or indirectly, by direct or indirect results from our scientists' research outputs. We draw over the broad conceptualization of beneficiaries proposed by Grant (2007, 395): *"Beneficiaries can include individuals and social collectives* internal or external to the organization, such as co-workers, supervisors, subordinates, *clients, customers, patients, and communities"* to compile a list of potential beneficiaries of biomedical research. We pilot-tested the list of beneficiary groups with biomedical researchers. That allowed us to refine the list by dropping, adding or merging beneficiaries, ending up with a final list of ten beneficiary groups. In the survey, respondents were asked to report their perceived impact over each beneficiary group. Specifically, we asked respondents, *"Research activities that you carry out has an impact across diverse groups. Please, indicate* to what extent the following groups benefit from the results obtained from your research *activities"*. Each beneficiary type was framed on a Likert scale, ranging from 1 (low importance) to 7 (high importance).

To build our dependent variables, we conducted a principal components factor analysis (PCFA) on the responses obtained in the survey. The analyses returned a three factor-factor solution. A table with factor loadings can be found in Table 3. The first factor consisted on those beneficiaries located within the academic boundaries (e.g.: scientists from respondents' own academic discipline). We labelled this category academic community ($\alpha = 0.66$). The second factor comprises beneficiary groups that belong to the commercial side (e.g.: pharma industry) ($\alpha = 0.67$). We labelled this factor as industry. And the last component was tagged as patients & clinical staff, since it covers beneficiary groups belonging to the clinical and patient side of biomedical research (e.g.: patients, clinical staff) ($\alpha = 0.78$). Our three dependent variables are built by averaging the score of the items comprised in each category.

In the sample, academic community is logically the main perceived beneficiary of research, followed by patients and clinical staff. Industry ranks the lowest.

{Table 3 here}

3.3. Independent variables

Motivation types. One of the most reliable scales for operationalizing motivations is the one based on the items from the Self-Regulation Questionnaire (SRQ) (Ryan and Connell, 1989). In the context of the current research, we aimed to capture a domain-specific motivation type, namely the motivation types to engage in biomedical research activities. Specifically, an introductory question in the survey asked, "Why do you engage in biomedical research activities?", and a list of items adapted from the SRQ was provided for each motivation type. Some items to capture autonomous motivation were "…because I enjoy it", "…because I find it interesting" or "…because I find it personally satisfying" ($\alpha = 0.73$). Similarly, items to capture controlled motivation were worded in the following terms: "…because I want to increase my economic earnings", "…because I want to obtain recognition from my academic community" or "…because I want to improve my professional position" ($\alpha = 0.80$). The scale that we used to capture prosocial motivation is also adapted from the SRQ and has been previously employed, showing adequate reliability (Grant, 2008; Grant and Sumanth, 2009).

Items from this scale include motives such as "…because I care about benefiting others through my work" or "…because it is important to me to do good for others through my work" (α = 0.87). Respondents score high in autonomous and prosocial motivation (mean equal to 6), which suggests complementarity between fulfilment of personal goals and feeling useful to others. They score lower in controlled motivation (3.7), so external influences matter, but not that much.

Personality traits. The survey instrument to capture scientists' personality traits is based on the mini-International Personality Item Pool (IPIP) scale developed by (Donnellan et al., 2006) and validated in a number of subsequent studies (e.g.: (Bellé, 2013; Grant and Wrzesniewski, 2010). This scale is derived from a longer form of items from the IPIP (Goldberg, 1999). The five-factor model of personality traits measures individual differences of the basis of big five stable personality traits (see section 2.2). Previous studies have shown support for the big five structure as. Each item is a descriptive phrase, (e.g. "I sympathize with *others' feelings", "I am not interested in abstract ideas*"), and respondents were asked to assess how accurately this phrase is for them, using a 7-point, Likert-type scale ranging from 1:'disagree strongly' up to 7: 'agree strongly'. After reversing some of the items, scores for individual items were averaged to produce a global score for each of the five personality traits, i.e. extraversion (Cronbach's α = 0.70), agreeableness (α = 0.63), conscientiousness (α = 0.71), neuroticism (α = 0.61) and openness to experience (α = 0.64). We also conducted a confirmatory factor analysis to test for reliability, confirming that items clearly grouped in five factors. Researchers in the sample exhibit high degree of agreeableness, conscientiousness and openness, not so much of extraversion and neuroticism.

3.4. Control variables

Individual socio-demographic variables. A number of control variables were included in our models based on our literature review on the potential determinants of perceived beneficiary impact, both at the individual and at the research-team level. Age of respondents was included because some studies have shown age of scientists to be related to their propensity to participate in activities related to the commercialization of science (D'Este and Perkmann, 2011; Haeussler and Colyvas, 2011). Likewise, scientists' gender (coded 1 for female and 0 for male) were included to account for gender-based differences. We also accounted for scientists' status in their research group. This was a categorical variable calculated as the average of five categories: principal investigator (PI), post-doctoral researcher with projects as a PI, post-doctoral researcher without projects as a PI, pre-doctoral researcher or technician. They range from 0 (technician) to 4 (PI), i.e. higher values correspond to higher status. We also took into account the type of contracting relationship that each respondent may have with the CIBER research group. A dummy variable indicated whether respondent is employed by the group, else affiliated to the group but employed by other institution, or has any other contract type.

The average individual is around 42 years old. 55 percent are female, 45 percent male. The mean value of status is 2, indicating that many individuals are in a middle stage of their careers (postdocs without projects as PIs). 22 percent of the respondents are actually employed by CIBERs, the rest are affiliated or have other contracting relationship.

Individual research related variables. We also accounted for scientists' research mobility experience. The survey asked scientists to indicate the length (in months) that they have spent on pre-doctoral or post-doctoral research stays at different institutions from the one they were currently employed. We express the resulting variable in number of years. Because scientists performing research closer to the clinical side may be more prone to be particularly aware on their perceived impact over non-academic beneficiary groups, we control for it with a set of dummies. To control for it, we asked respondents whether they mostly perform basic research, clinical research, or both of them. We then build a variable –degree of clinical research-, which is the average of three values: 1 (basic research), 2 (basic and clinical research), 3 (clinical research). Next, we controlled for the respondents' distribution of their working time. Specifically, we asked respondents to distribute their working time on a regular week between a set of proposed tasks: research, teaching, patients' care, administrative duties, development of relations with external colleagues, and other activities. The sum of all variables is 100 percent. For the estimation, we take the most frequent one (% research time) and compare it to the rest.

Our individuals tend to have one year of research mobility experience. Variable nature of research has a mean value of 2, indicating a middle degree of clinical orientation in the sample. Individuals allocate an average of 59 percent of their time to research activities and 41 percent to others (the rest of categories are much lower in scale, e.g. the second largest one is administrative duties with only 13 percent of time allocation).

Supra-individual variables: group, sub-field, institution and region. Our models control for the previous academic and technological experience of the principal investigator (PI) of the research group where each respondent belongs. Recent research evidences that the PI plays a lead role in orienting research groups' scientific interests and contributions (Boehm and Hogan, 2014). We operationalize the potential influence of the PI with two additional control variables. The first one (PI academic papers) indicates the number of academic papers previously published by the PI. For each principal investigator, we also recovered patent data from PATSTAT on the number of patent applications submitted during the period 1998 – 2010 (PI patent applications). We also included a set of control variables to account for differences on the scientific sub-field where respondents belong as well as on the nature of scientific activities they perform. We use nine dummies to identify the CIBER program where each scientist belong. As stated above, each CIBER program is focused on a biomedical sub-field, ranging from obesity (CIBER-EHD) to diabetes and metabolic diseases (CIBER-DEM). We expect that the institution type where respondents are located may exert an impact on their perceived beneficiary impact, due to the divergent institutional logics provided by each institution type (Dunn and Jones, 2010). To control for institutional effects, we included four dummy variables: university, hospital/clinic, public research organization and other type of institution, being the latter our reference category. Finally, the location of our sample of research groups is quite concentrated in the two largest cities in Spain: Madrid and Barcelona. To account for potential geographical effects, we included the dummy variable region (1 = Madrid or Barcelona, 0 = any other location).

In this sample, the typical group's PI has published 56 papers (0.56 in the table because the variable has been divided into 100 for reasons of scale) and invented one patent. The distribution by type of institution is as follows: 32% hospitals, 31% university, 27% PROs, 10% private and other research organisations. 63% of respondents are located in Madrid or Barcelona.

4. Results

We report the results of the linear regressions in Table 4. We cluster the observation by research groups to guarantee the independence of the error terms. Odd models include control variables only, even models also psychological variables. By comparing the r-squares, it is possible to notice a substantial increase in predictive power in the latter models (Wald tests consistently indicate the increase is significant).

{Table 4 here}

We will consider that the estimations verify Hypothesis 1 if some coefficients in common between odd and even models change significance after the inclusion of psychological variables.

On the one hand, many coefficients do not support Hypothesis 1. Age does not have a significant impact on any beneficiary type, as in other research (Boardman and Ponomariov, 2009). Being female has a negative influence on addressing industry, not academic community or patients. The former negative effect is consistent with previous studies (Azagra-Caro et al., 2006; Boardman and Ponomariov, 2009). Status is positively associated with orientation to the academic community, not to industry or patients, a natural consequence of incentives for promotion within the academic world (Bozeman and Gaughan, 2007). The more clinical the nature of research, the fewer the perceived impact on academic community, the higher on patients and none on industry. Type of contractual relationship with the CIBER does not exert any significant effect. Neither number of published papers nor of patents invented by the group's PI affect beneficiary types. Dummies for affiliations to a concrete CIBER are jointly significant for orientation to industry and patients, not academia, suggesting that all these sub-fields pursue similar academic objectives but vary according to the degree of openness to other stakeholders. Location in one of the two main regions in terms of agglomeration do not count in terms of perceived impact of research.

On the other hand, other coefficients support Hypothesis 1. Research mobility pushes academic and industrial orientation of results upwards, only when psychological variables appear in the equation (Models 2 and 4). The inexistent association in the absence of psychological variables may recall the fact that the benefits of mobility for scientific production are not clear (Fernandez-Zubieta et al., 2013). However, the final result confirms previous positive association between stays abroad and university-industry interaction, probably due to the fact that researchers choose moving to academic environments better than their own, and learn from hosts how to combine academic and industrial agendas (Azagra-Caro et al., 2006). A higher proportion of time available for research increases perceived impact on academic community and industry as beneficiaries, but this does not hold for academia when we include psychological variables (Model 2). Institutional type does not have any impact on addressing research to academic researchers or industry, but to patients, once we account for the influence of psychological variables (Model 6). The latter is due to a significantly lower propensity of universities and public research organisations to devote efforts to patients (compared to hospitals and private research organisations).

Because of these changes in the effects of research mobility, share of research time and institutional type, we consider there is evidence in favour of Hypothesis 1. The results suggest that the inclusion of psychological motivations and traits modifies the importance of individual research-related variables for academic and industrial orientation (not of demographic or supra-individual ones) and that of a supra-individual variable (institution type) for orientation to patients.

Testing the rest of hypotheses is more straightforward. The three types of motivation (autonomous, controlled, prosocial) have positive effects on the three beneficiaries of research: academia, industry and patients (Models 2, 4 and 6). Thus, Hypothesis 2 holds. The only exception is the non-significant effect of autonomous motivation on conducting research with likely impact on industry: controlled and prosocial motivations are the drivers instead. One possible explanation is that researchers acknowledge outside support to academic-industry interaction and admit its social value, but they prefer to remain apart from the complexity of their costs and benefits (Welsh et al., 2008).

In contrast with the general positive effect of motivations on beneficiaries, only three out of the big five personality traits affect beneficiary type (openness to experience, extraversion and conscientiousness) and only one of them affects each beneficiary type at a time. This is compatible with Hypothesis 3. Given that the same individual can score high in these three personality traits, she can perceive her research as having impact on different beneficiaries. However, an individual scoring high in only one of those personality traits will not be able to address difference audiences, everything else constant. Two personality traits (agreeableness and neuroticism) remain out of any possible influence on beneficiary types. Compared to the typical complex pattern of the effect of the big five on other phenomena (see reasoning behind Hypothesis 3), all this depicts a simpler, univocal relationship, maybe because ordering individual preferences for one type of audience or another is not such a complex problem. Our finding also reveals that many barriers usually found in the literature on academics' interaction with industry and openness to patients are deeply rooted in stable personal characteristics that situate scientists in an a priori condition irrespective of contextual or institutional influences.

Moving forward to the three specific relationships found, the results show that openness to experience, extraversion and conscientiousness have a positive impact on having the academic community, industry or patients as main beneficiaries, respectively. This confirms Hypotheses 4 to 6. A very recognisable feature of a scientist, being curious and open-minded (i.e. open to experience) suffices to address his pairs. In order to address outer communities, he needs to be an extrovert, which will make him eager to engage into commercial activities, or conscientious, which will give him the willingness to devote time to non-routine tasks such as caring about patients. This later insight, in relation with the already mentioned lower importance of patient-related research for universities and public research organisations, suggests that even in such unfavourable institutional contexts, it is possible to find individuals able to overcome the obstacles. This may be behind differences between institutional and personal modes of governance of academic's external interaction (Bodas Freitas et al., 2012).

5. Conclusions

Analysing the societal impact of science in terms of beneficiaries is of undoubted interest to policymakers. Increasingly, scientific advancements are evaluated in light of their societal impact and bridging the “relevance gap” has become a policy priority (Nightingale and Scott, 2007). In the biomedical field, a similar debate has been tackled by the translational research paradigm, which advocates for a closer dialog between basic science producers and potential beneficiaries of its results, such as patient representatives or industrial actors. Still, medical progress is highly dependent on the advancements produced in basic research (Contopoulos-Ioannidis et al., 2003). At its nascent stage, biomedical research is pursued in contexts where potential applications of research results still seem a distant goal. It is also at this stage where scientists hold most of the decision rights over the orientation of their research projects (Tartari and Breschi, 2012). Thus, exploring the extent to which scientists are concerned about other groups when performing their research activities becomes highly opportune. In this respect, a first objective of this paper is to clarify who are the main perceived beneficiaries in biomedical research, from a scientist’ viewpoint. As pointed out by organizational psychology scholars (Belle, 2014; Grant and Campbell, 2007), raising awareness about the impact that ones’ tasks has on beneficiary groups is associated to increased levels of performance and dedication, and results in extra efforts to reach these perceived beneficiary groups.

Our survey data reveals that respondents discern the potential impact of their research activities over three specific beneficiary groups: academic community, industry and patients and clinical staff. Results indicate that the academic community is still perceived as the primary beneficiary group of research, followed by patients and clinical staff, and industry. Yet at the same time, we observe that the relevance of beneficiaries from biomedical research is not evenly perceived by all researchers. Departing from this categorization of beneficiary groups, we then explore whether this observed heterogeneity may be predicted when psychological characteristics of scientists are considered. In addition to demographic, economic, group, institutional and regional variables, including scientists' motivations and personality traits improves the predictive power of all our models. In particular, results suggest that the greater scientists' autonomous, controlled and prosocial motivation strength, the greater their awareness of the effects of their research on all beneficiary groups. We also observe that psychological traits also predict perceived beneficiary impact. Specifically, we found that scientists scoring high on openness to experience have a greater subjective awareness of their perceived impact on academic peers. Those scoring high on extraversion are more likely to be aware of their impact on industrial actors. And those scoring high on conscientiousness are more prone to give more weight to their perceived impact on patients and clinical staff.

From a policy perspective, our results make a number of contributions for research centres and policymakers keen to generate science with a greater potential for application. It seems clear that policy initiatives to involve non-academic actors into the research process should be tailored. An explicit consideration of the heterogeneous preferences and personality traits seems to indicate that, ceteris paribus, not all scientists are equally equipped to incorporate external influences into their research agendas. Thus, policies based on one-size-fits-all incentives may be only partially effective. The additional explanatory power of psychological differences shown by our results offers a path to design more targeted policies. For instance, our findings suggest that policies promoting the mobility of researchers as a way to raise their awareness about industrial actors' needs should be taken into consideration. The positive effect of mobility experience on perceived beneficiary impact on industry appears to hold only for certain psychological profiles. Similarly, the apparent relationship between the amount of time devoted to scientific research and the consideration of academic peers as the primary beneficiary group of one’s contributions is not that clear when psychological characteristics come into play. Policymakers need to be aware of these issues, and scientific hiring policies can take account of the fact that certain psychological profiles may be better suited to incorporate societal need into the research process. Indeed, this line of research deserves further attention. Future research could tackle this perspective in order to analyse the fit between various psychological profiles and the strategic objectives of a certain lab or research group.

In addition, our findings suggest that policymakers should bear in mind the key role of motivation as a way to boost the scientists’ perceived impact on diverse beneficiary groups. Thus, we observe opportunities for interventions aimed to shape the current incentive structures as a way to increase scientists’ perceived beneficiary impact. Our results also show a non-significant relationship between scientists’ autonomous motivation and perceived impact on industry. Thus, another avenue for research may advance on the understanding of this relationship and to assess its generalizability. For instance, by developing qualitative studies of cases where scientists driven by autonomous motivation have been successfully engaged with industrial actors.

This study is subject to limitations. For example, we mainly rely on survey data to build our variables. While we collected information on a large number of researchers, and self-reported data is a common procedure in motivational and psychological studies, we acknowledge the limitations associated to this approach. Future research should rely on secondary sources indicators (e.g. involvement in patenting or in meetings with patients) to proxy for perceived beneficiary impact.

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Tables

Table 1 Descriptive statistics (N=1033)

	Mean	Standard deviation	Minimum	Maximum
Academic community	5.40	1.28	1.00	7.00
Industry	3.39	1.53	1.00	7.00
Patients and clinical staff	4.41	1.43	1.00	7.00
Autonomous motivation	6.17	0.81	1.00	7.00
Controlled motivation	3.71	1.16	1.00	7.00
Prosocial motivation	6.02	1.02	1.00	7.00
Openness	5.35	1.00	1.00	7.00
Conscientiousness	5.62	1.00	1.25	7.00
Extraversion	3.93	1.18	1.00	7.00
Agreeableness	5.69	0.93	2.00	7.00
Neuroticism	3.38	1.09	1.00	7.00
Age	41.62	10.39	23.00	74.00
Gender (female)	0.55	0.50	0.00	1.00
Status	2.09	1.13	0.00	4.00
CIBER employee	0.22	0.42	0.00	1.00
Mobility	1.01	1.90	0.00	17.58
Clinical research	2.02	0.87	1.00	3.00
% research time	0.59	0.29	0.00	1.00
PI papers	0.56	0.49	0.03	2.95
PI patents	1.04	2.35	0.00	21.00
University	0.31	0.46	0.00	1.00
Hospital	0.32	0.47	0.00	1.00
Public research organization	0.27	0.45	0.00	1.00
Madrid or Catalonia	0.63	0.48	0.00	1.00

Table 2 Correlations (N=1033)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	Academic com.	1.00																							
2	Industry	0.33*	1.00																						
3	Patients	0.24*	0.29*	1.00																					
4	Autonomous mot.	0.39*	0.11*	0.22*	1.00																				
5	Controlled mot.	0.25*	0.22*	0.18*	0.24*	1.00																			
6	Prosocial mot.	0.32*	0.16*	0.30*	0.56*	0.23*	1.00																		
7	Openness	0.22*	0.07*	0.05	0.28*	-0.04	0.18*	1.00																	
8	Conscientiousness	0.10*	0.01	0.13*	0.09*	0.08*	0.21*	0.00	1.00																
9	Extraversion	0.08*	0.10*	0.08*	0.12*	0.10*	0.13*	0.18*	-0.02	1.00															
10	Agreeableness	0.15*	0.04	0.13*	0.16*	-0.01	0.27*	0.25*	0.18*	0.25*	1.00														
11	Neuroticism	-0.07*	0.00	-0.01	-0.11*	0.02	-0.04	-0.18*	-0.08*	-0.10*	-0.06	1.00													
12	Age	-0.02	-0.02	0.09*	-0.06	0.11*	-0.09*	-0.05	-0.10*	-0.14*	-0.08*	0.01	1.00												
13	Gender (female)	0.03	-0.10*	-0.01	0.05	-0.09*	0.12*	-0.10*	0.19*	0.12*	0.20*	0.07*	-0.25*	1.00											
14	Status	0.11*	0.06*	0.07*	0.06*	0.09*	-0.01	0.05	-0.14*	-0.03	-0.04	0.01	0.60*	-0.25*	1.00										
15	CIBER employee	0.05	0.01	0.02	0.04	-0.11*	0.08*	0.05	0.13*	0.05	0.11*	-0.03	-0.28*	0.19*	-0.29*	1.00									
16	Mobility	0.13*	0.08*	-0.08*	0.08*	-0.06*	0.00	0.08*	-0.06	-0.06	-0.02	0.03	0.18*	-0.06	-0.10*	0.32*	1.00								
17	Clinical research	-0.16*	-0.02	0.35*	-0.07*	0.10*	-0.03	-0.05	-0.01	0.01	0.03	-0.02	0.16*	-0.04	-0.09*	0.07*	-0.21*	1.00							
18	% research time	0.12*	0.10*	-0.10*	0.18*	-0.09*	0.16*	0.09*	0.13*	0.06	0.07*	-0.08*	-0.50*	0.23*	0.29*	-0.36*	0.00	-0.35*	1.00						
19	PI papers	0.02	0.04	-0.04	0.03	0.05	0.01	0.06*	0.02	0.04	0.05	-0.04	-0.02	-0.08*	-0.04	0.06	-0.02	-0.03	-0.03	1.00					
20	PI patents	0.03	0.11*	-0.10*	0.04	0.03	0.04	0.02	0.00	-0.06*	-0.04	0.03	-0.08*	-0.03	0.04	-0.03	0.02	-0.09*	0.11*	0.21*	1.00				
21	University	0.03	0.02	-0.15*	0.06	0.06*	0.06	0.01	-0.09*	-0.01	-0.05	0.05	-0.04	0.00	-0.04	0.04	0.03	-0.25*	0.05	-0.01	0.14*	1.00			
22	Hospital	-0.08*	-0.04	0.22*	-0.07*	0.03	-0.04	-0.07*	0.04	0.00	-0.02	0.00	0.20*	-0.11*	-0.04	0.10*	-0.10*	0.43*	-0.40*	0.06	-0.20*	-0.46*	1.00		
23	PRO	0.02	0.00	-0.08*	0.03	-0.07*	0.00	0.01	0.04	-0.02	0.06	-0.02	-0.11*	0.15*	0.09*	-0.12*	0.06	-0.13*	0.28*	-0.05	0.08*	-0.41*	-0.42*	1.00	
24	Madrid or Cat.	-0.02	0.00	0.01	0.01	-0.02	-0.01	-0.01	0.02	0.03	0.05	-0.07*	0.01	0.07*	0.03	0.00	0.05	0.07*	0.01	0.11*	-0.02	-0.21*	0.11*	0.10*	1.00

* p<0.05

Table 3 Component rotated matrix: perceived impact on beneficiaries

	Research community	Industry	Patients and clinical staff
Academics from your own group	0.87		
Academics from your own field	0.81		
Pharma industry		0.60	
Other industries		0.83	
Other collectives		0.72	
Patients			0.87
Patients’ relatives			0.82
Clinical staff			0.77
Vulnerable societal groups			0.67

Extraction method: principal component analysis. Rotation method: varimax normalization with Kaiser. Only factor loadings greater than 0.3 are displayed.

Table 4 Linear regressions of the perceived impact of research on different beneficiary types

	1 Academic community	2 Academic community	3 Industry	4 Industry	5 Patients & clinical staff	6 Patients & clinical staff
Age	-0.01 (0.01)	-0.00 (0.00)	-0.01 (0.01)	-0.00 (0.01)	0.00 (0.01)	0.00 (0.00)
Gender (female)	0.09 (0.08)	0.09 (0.08)	-0.34** (0.11)	-0.36** (0.11)	-0.02 (0.09)	-0.15 (0.09)
Status	0.19** (0.05)	0.12** (0.04)	0.10 (0.06)	0.07 (0.05)	0.07 (0.05)	0.03 (0.05)
CIBER employee	0.12 (0.10)	0.13 (0.09)	0.13 (0.14)	0.17 (0.13)	0.15 (0.12)	0.13 (0.12)
Mobility	0.05 (0.02)	0.05* (0.02)	0.04 (0.03)	0.05* (0.03)	-0.01 (0.02)	-0.00 (0.02)
Clinical research	-0.14** (0.05)	-0.19** (0.05)	0.13 (0.07)	0.09 (0.07)	0.56** (0.06)	0.52** (0.05)
% research time	0.47** (0.18)	0.09 (0.16)	0.69** (0.21)	0.62** (0.22)	0.31 (0.19)	0.01 (0.19)
PI papers	0.01 (0.08)	-0.06 (0.07)	-0.03 (0.09)	-0.07 (0.09)	-0.15 (0.10)	-0.18 (0.10)
PI patents	0.01 (0.02)	0.01 (0.01)	0.04 (0.02)	0.04 (0.02)	-0.01 (0.03)	-0.02 (0.03)
CIBER dummies	Included Not sig.	Included Not sig.	Included Sig.	Included Sig.	Included Sig.	Included Sig.
Institutional dummies	Included Not sig.	Included Not sig.	Included Not sig.	Included Not sig.	Included Not sig.	Included Sig.
Mad. & Cat. dummy	-0.05 (0.08)	-0.07 (0.07)	0.04 (0.11)	0.05 (0.11)	-0.08 (0.10)	-0.07 (0.09)
Autonomous mot.		0.33** (0.07)		-0.10 (0.07)		0.17** (0.06)
Controlled mot.		0.23** (0.04)		0.27** (0.04)		0.08 (0.04)
Prosocial mot.		0.11* (0.05)		0.17** (0.05)		0.31** (0.05)
Openness		0.15** (0.04)		0.03 (0.05)		-0.03 (0.05)
Conscientiousness		0.04 (0.03)		-0.02 (0.05)		0.11** (0.04)
Extraversion		-0.02 (0.04)		0.10* (0.05)		0.04 (0.04)
Agreeableness		0.08 (0.04)		0.01 (0.06)		0.04 (0.06)
Neuroticism		-0.03 (0.03)		0.04 (0.05)		0.04 (0.04)
Constant	5.07** (0.34)	0.81 (0.53)	2.96** (0.41)	1.11 (0.65)	2.86** (0.32)	-0.84 (0.49)
Observations	1033	1033	1033	1033	1033	1033
Clusters	319	319	319	319	319	319
F	3.49	11.72	4.27	6.54	11.12	17.56
p	0.00	0.00	0.00	0.00	0.00	0.00
R^2	0.07	0.26	0.08	0.14	0.18	0.29
Adjusted R^2	0.05	0.23	0.06	0.12	0.16	0.27

* Significant at 5%. ** Significant at 1%. Standard errors in parenthesis. No multicollinearity according to variance inflation factors. Hightlighted: parameters whose significance changes when pshycological variables are included.